

Standards in Sustainable Landscape Architecture

Cayce Bean and Chia-Hui Yang (Mayla)



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Fig. 01 Kresge Foundation Headquarters, Troy, Michigan

Sustainable Landscape Architecture

Sustainable landscape architecture creates ecological designs for the outdoor and urban environment. It begins with appropriate systems which address function, cost, energy efficiency, beauty, and the environment. Broadly speaking, sustainable landscape architecture is the integration of ecological, social, cultural, and economic factors in designing landscapes to help protect habitat, contribute to stormwater management, conserve water, among other objectives. The current trend in the practice of landscape architecture is to find the balance of “aesthetics and function” required for successful sustainable design.¹

Sustainability vs. Conservation

The Chesapeake Conservation Landscaping Council (CCLC) defines “Eight Essential Elements” for conservation landscaping.² The

goals of these eight parameters address environmental benefits. Sustainability and conservation landscaping both strive to work with nature to reduce air pollution, increase water quality, lower water consumption, utilize native plants, and reduce usage of pest control. However, sustainability and conservation differ in the emphasis sustainability places on addressing social and economic factors in addition to environmental factors. In other words, conservation can be seen as the environmental part of the sustainability concept.

Scope

The first part of this paper examines the Sustainable Sites Initiative as an example of a current benchmark and rating system for landscape architecture. The second part of this paper addresses the concept of living systems and details two materials, water and vegetation, which are relevant to



Fig. 02 Aspects of Sustainability

both the Sustainable Sites Initiative and to living systems. This section also concludes with a few examples of living systems strategies.

Sustainable Sites Initiative

History and Objectives

The Sustainable Sites Initiative grew out of a conference hosted in 2005 by the American Society of Landscape Architects (ASLA), the Lady Bird Johnson Wildflower Center. The United States Botanical Garden (USBG) joined the effort in 2006 when the initiative officially began. The United States Green Building Council (USGBC) became a stakeholder in 2007.³

The main goals of the initiative are to create a set of guidelines and benchmark which become a stand alone guide and rating system for site sustainability and to serve as a supplement for other

building guidelines and rating systems. To this end, the USGBC anticipates eventual adoption in to their Leadership in Energy and Environmental Design (LEED) program. The Sustainable Sites guidelines, however, will not apply only to sites with buildings, rather, “the Initiative seeks to apply sustainability principles to any site, with or without buildings, which will be protected, developed or redeveloped for public or private development.”⁴ The Initiative sees the opportunity for the guidelines to be applied to a wide range of projects from parks to college campuses to utility corridors. To achieve this broad application, the stakeholders are also interested in partnering with local organizations over common objectives.⁵ The draft report of Performance Benchmarks was released in 2008 and the Performance Benchmarks were released November 5, 2009. In October 2009, the Sustainable Sites

Initiative won a 2009 Green Business Award.

Overview

The initiative's definition of sustainability derives from the well-known Brundtland report. To be sustainable, a site has “design, construction, operations, and maintenance practices that meet the needs of the present without compromising the ability of future generations to meet their own needs.”⁶ Sustainable sites do not only mitigate negative impacts on the environment, but are a mutual benefit to the site itself and the people who use it. In addition, a sustainable site must address social, environmental, and economic concerns. The economic aspects addressed must take into account the value of the natural systems of the site. This is the root of the program's ecosystems services framework. In other words, the guidelines have been built around the concept that people receive benefits, in the form of goods and services from healthy ecosystems.

Ecosystem services

Ecosystems provide goods and services to us that without which we would not be able to survive. Often, when evaluating the economic considerations of a development project, these services are inadequately valued or neglected entirely. This can result in an inaccurate analysis that hides many of the potential costs and benefits to the project and to the site. In addition to these more tangible factors, ecosystems can contribute to “our healthy, our prosperity, our security, and to our social and

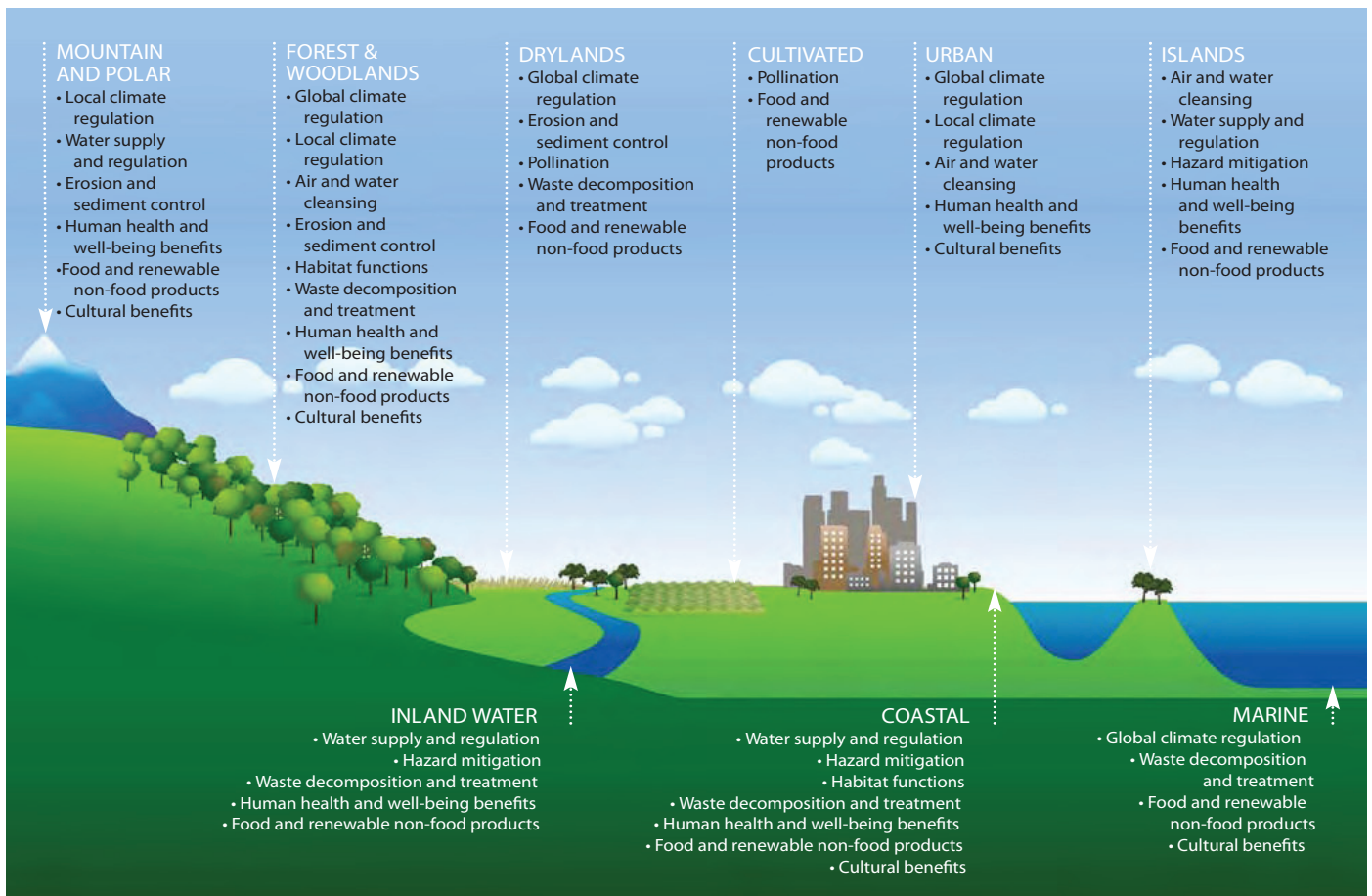


Fig. 02 Examples of some of the goods and services various ecosystems can provide for communities.

cultural identity.”⁷

The initiative has defined twelve essential ecosystem services. A sustainable site should protect and enhance these services.⁸ The specified ecosystem services are:

1. *Global climate regulation*
2. *Local climate regulation*
3. *Air and water cleansing*
4. *Water supply and regulation*
5. *Erosion and sediment control*
6. *Hazard mitigation*
7. *Pollination*
8. *Habitat functions*
9. *Waste decomposition and treatment*

10. *Food and renewable non-food products*

11. *Culture benefits*⁹

Often, sites are not developed in a way to preserve these services or they are used and then abandoned as brownfields. Even brownfields, however, are performing some valuable ecosystem services and furthermore, could be restored in such a way to restore and enhance the ecosystem services of the site. In the restoration of brownfields, in particular, and the development of new projects, in general, there is a challenge to convince developers that changing conventional site

strategies is a cost worthy expense. This means “presenting an accurate valuation of the benefits of ecosystems.”¹⁰

Ecosystem services are the structure for the Initiative’s guidelines because they believe that any landscape “holds the potential both to improve and to regenerate the natural benefits and services provided by ecosystems in their undeveloped state,” and that sites can be developed in a way to enhance these services and improve the benefits for the humans and the ecosystem.¹¹

Guidelines and Benchmarks

The goal of the initiative produced performance benchmarks is to “develop credits that would shift the landscape development and management market toward sustainability while still being practical and achievable.”¹² This focus on achievable outcomes, however, is not an allowance for less rigorous solutions – the bar has been set high. The stakeholders have acknowledged that defining the credits and how they are quantified and measured will need to be an evolving process, adapting to new conditions, technologies, and trends, in addition to responding to the performance of previously attempted solutions.

The benchmarks are performance based and interrelated for several reasons. Ecosystem conditions cannot be generalized between region. A strategy that works positively in one region may be neutral or detrimental in another region. The credits are designed to encourage a holistic approach to site development because it is the view of the stakeholders that no one successfully addressed credit, or issue, can make a site sustainable.¹³ However, prerequisite credits must be met to qualify as a sustainable site. There is a process for amending the prerequisites since the stakeholders acknowledge that not all apply to every site. Credits that are benchmarks that are optional.

The credits are categorized and structured in such a way as to guide the project team through the process from site selection to operations and maintenance.¹⁴ The seven major framework categories are:



Fig. 04 Landscape Architecture integrate the Living Material to build the Living Systems

1. *Site Selection*
2. *Pre-design Assessment and Planning*
3. *Site Design – Ecological Components*
4. *Site Design – Human Health Components*
5. *Site Design – Materials Selection*
6. *Construction*
7. *Operations and Maintenance*

Each benchmark addresses a specific set of ecosystem services as related to one of five expertise areas: soils, vegetation, hydrology, materials selection, and human health and well being.¹⁵ These topics are identified as the key technical areas that must be addressed by sustainable sites.

Living Systems

The idea of living systems broadens

the concept of landscape materiality, rejecting nature as naturally occurring and instead embracing it as a dynamic set of constructed systems. In living systems, landscape architecture integrates living materials such as plants and water working within the complex behaviors of biological systems. Landscapes are also viewed as a series of cyclical and evolving processes in which materiality is defined in terms of capabilities, growth, decay, exchange, conversion, adaptation, retention, infiltration, and evaporation. As a system of continual flux, exchange, and transformation, landscapes must be integrated into their design propose and material structure, not just an applied surface layer.¹⁶ Living systems incorporate many of the technical areas of the Sustainable Sites Initiative including:

urban ecologies, new adaptable sites, stormwater management, and climate control, vegetation, and hydrology among others.¹⁷

Living Materials -Water

Water covers 70% of the Earth and essential to life in general and sustainability and landscapes in particular. With respect to sustainable landscapes it is important to understand water as a system rather than a substance. When analyzed as a system, less emphasis is placed on controlling location and more emphasis is placed on the effects of surface interventions on the movement of water locally and regionally.¹⁸ It is also important for designers to have a basic understanding of the hydrological cycle.

The hydrological cycle, also known as the water cycle, describes the way that water moves through our ecosystems. As it is a never-ending cycle it is important to protect water at every step of the process.¹⁹

There are three major factors which influence the way that water performs on a specific site: the quantity of water, the material over which the water runs, and shape of the land over which the water runs. A moderate amount of water flowing over a gentle slope with porous soil will likely be absorbed by the soil. The same amount of water on a steeper slope with impervious material will run-off to a different location.²⁰ Due to these factors, it is easy to see how construction greatly effects water performance. Soils can be compacted or replaced with paving materials and slopes can be regraded leading to more runoff

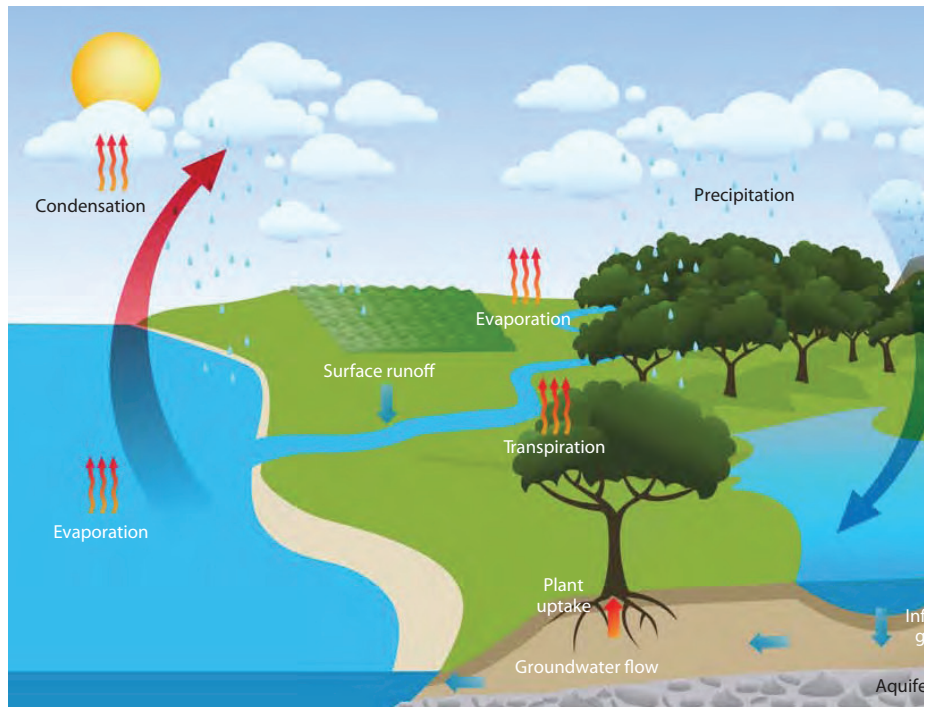


Fig. 05 The Hydrological Cycle

and greater erosion. Conversely, sensitively addressing these factors can enhance a site dramatically in addition to improving conditions on neighboring sites and enhancing the local watershed.

In the scope of this section the following topics will be addressed: storm water, water collection, and constructed wetlands.

Stormwater

Stormwater is water that hits the earth as precipitation. While stormwater through infiltration is they way in which our ground water, streams, and lakes are recharged, there are two major issues regarding the problem of excess stormwater: volume and pollution. Excess volume generally leads to flooding while surface and atmospheric

pollutants can contaminate drinking and groundwater.

This excess volume, when not managed on site, is called runoff. In other words, runoff is “rainwater that can’t be collected where it falls.”²¹ Like stormwater, runoff can be a major source for some bodies of water, but excess runoff can also cause flooding downstream. It can also lead to erosion due to an unexpected amount of water flowing over a steeper slope or softer soil.

Runoff is also a major source of pollution; for example, contaminants, including bacteria, on pavements are easily washed away and taken into the hydrological cycle.²² Pavements and other impervious surfaces are also a major contributing factor to an increase in runoff because these surfaces greatly decrease

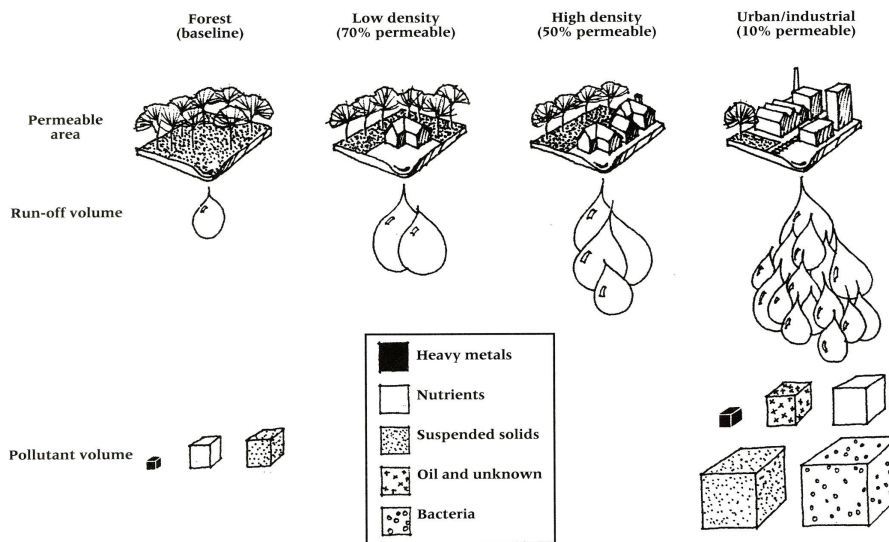


Fig. 06 Comparative surface runoff and pollutants

the absorption of a given area of land. Due to these increases in pollution and potential flooding, reduced infiltration capacity is “one of the single most serious barriers to sustainability.”²³

Stormwater management is most efficient and cost effective if controlled where the precipitation hits the earth. The reasons for this are simple. As runoff moves over greater distances its speed increases and it accumulates more volume in a snowball effect. Volume and speed, while problematic on their own, are also primary factors in the erosive properties of water.

There are two main explanations of why, despite these factors, often storm water is not managed closed to its source. The first is that upstream landowners may choose not to or do not adequately manage their runoff. In this case, the downstream landowner has little choice and must manage the storm water or continue to send it

downstream to the next landowner. The second reason is that larger scale techniques are perceived as having economies of scale. In this view, costs related to performance and maintenance are largely ignored; this is a faulty view however, because capital costs fail to reveal a complete picture. Reinforcing this point, according to one study, “at least in the Eastern United States, every gallon of water properly managed on-site saves at least \$2 in engineering downstream.”²⁴

Water Collection

Historically, many cultures have taken advantage of water collection systems. Additionally, as recently as the turn of the 20th century many houses often had water harvesting systems and cisterns. Water harvesting is defined as “the collection and storage of rainwater from roofs, paved surfaces, and the landscape.”²⁵ Systems for water collection vary in size and scope from a single barrel at the

end of a gutter to a “multiple end-use system at a large corporate campus.”²⁶ The key difference is that with water harvesting, water is seen as a resource, as opposed to the conventional water management view of excess water as something to be controlled and mitigated.²⁷

Almost any surface can be used to collect water, but a few guidelines should be followed. Firstly, the water collected from paved surfaces cannot be used as drinking water, but can serve for plant watering and countless other water needs. If the surface is a low pollutant surface, such as paved surfaces with no vehicular traffic, then it can feed directly into a collector. If the surface is a pollutant surface, then before being collected it must go through a biofilter or bioswale.

The simplest water collection method, of course, is to grade the site toward a planted bed or wetland area. There are, however, a few precautions for this system. Care must be taken with every plant; grading the site increases the chances that specific plants will be either drowned or parched by this movement of water. Secondly, although ponds can be used strategically for many sustainable design strategies, they also can lose a significant amount of volume due to evaporation.²⁸

In addition to ponds, water can also be stored in containers either above or below ground. These tanks are generally made of metal, plastic, fiberglass, or concrete, but can also be made of stone or wood. Above ground, the tanks should be opaque because sunlight will increase the growth of algae. Below ground

tanks, although more expensive to install, have the added benefit of a more moderated temperature throughout the year. The use to which the water will be put should be considered when selecting the material because some can be toxic for drinking water.

Constructed Wetlands

Natural wetlands are sometimes called “earth’s kidneys” because they serve to filter out contaminants in the water of our ecosystems.²⁹ Wetlands slow the flow of water, allowing sediments to fall out. In addition, wetlands host a variety of plants and microorganisms that can serve to improve water quality. Constructed wetlands, in recent years, have begun to be promoted by many organizations, including the United States Environmental Protection Agency, as an alternative method to sewage treatment.³⁰ Some go so far as to say that “it is quite conceivable that within a few years it will be landscape professionals who deal with waste water treatment, not sanitary engineers.”³¹ Constructed wetlands have the potential benefits of having lower construction maintenance costs, being more aesthetically pleasing, and producing less odor than traditional treatment facilities.

The technology for constructed wetlands is not new; it originated in Germany in the 1960s and came to the United States in the 1980s. In fact, despite meager adoption in this country, over 5,000 constructed wetlands for the purpose of water treatment have been implemented in Europe.³² At its most basic, a constructed wetland is a shallow pond which is split into cells. Water

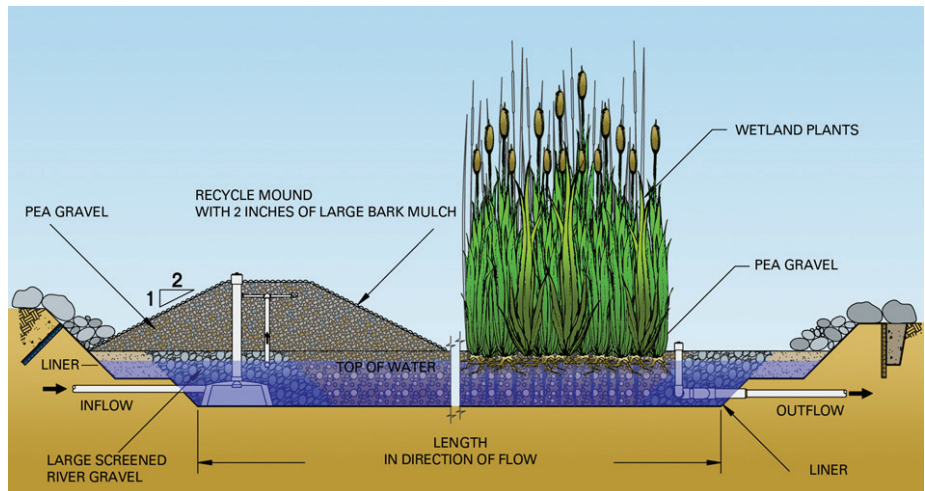


Fig. 07 Subsurface flow wetland

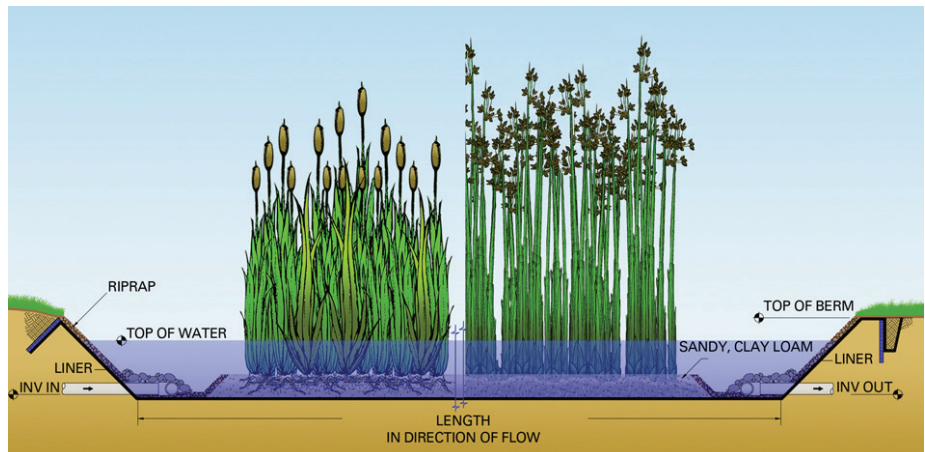


Fig. 08 Surface flow wetland

flows over a vegetation supporting substrate where roots and microorganisms filter pollutants.³³ Generally the ponds are 1 – 3 feet deep and have an impervious liner. The bottom is filled with gravel, or some other porous material capable of supporting plant life. The arrangement of the upper layers depends on the type of wetland, either subsurface flow or surface flow.

Subsurface flow wetlands, that is

wetlands without a flow of water directly on the surface, are used primarily near housing or office buildings because there is less risk of human contact, less risk of mosquitoes, and less odor. However, because they are covered, they are less reliable and harder to maintain if needed. With subsurface flow wetlands, the gravel in the ponds is topped with mulch and plants. When operating, the water flows under the mulch directly on top of the gravel.

In contrast, surface flow wetlands, have no or a very shallow mulch layer. Plants are grown in the gravel layer and when operating water flows directly on the surface. This system is less complex and therefore costs less to install and operate. It is also more efficient and it supports a more diverse wildlife habitat. The appropriate strategy is specific to each situation and should be evaluated on a site by site basis.³⁴

Living Materials - Vegetation

Xeriscaping

Xeriscape taken from *xeros*, meaning dry in Greek is a word firstly coined by the Denver Water Development in 1981 to set up an exemplary model of water saving landscapes.³⁵ In the western United States, more than 50% of residential water demand is used to keep landscapes and lawns green. Xeriscaping can reduce the water usage by 15% to 60%. Its basis is seven essential principles to reestablish natural environment:

1. *planning and designing,*
2. *limiting turf areas,*
3. *selecting and zoning plants appropriately,*
4. *improving the soil,*
5. *using mulch,*
6. *irrigating efficiently and*
7. *maintaining the landscape*³⁶

Xeriscape is often associated with cactus and rock gardens, but these landscapes can incorporate a wide variety of seasonally diverse species. The underlying tenets of Xeriscaping promote regionally and climatically appropriate landscaping with native plants, but also can and should be used to promote more sustainable

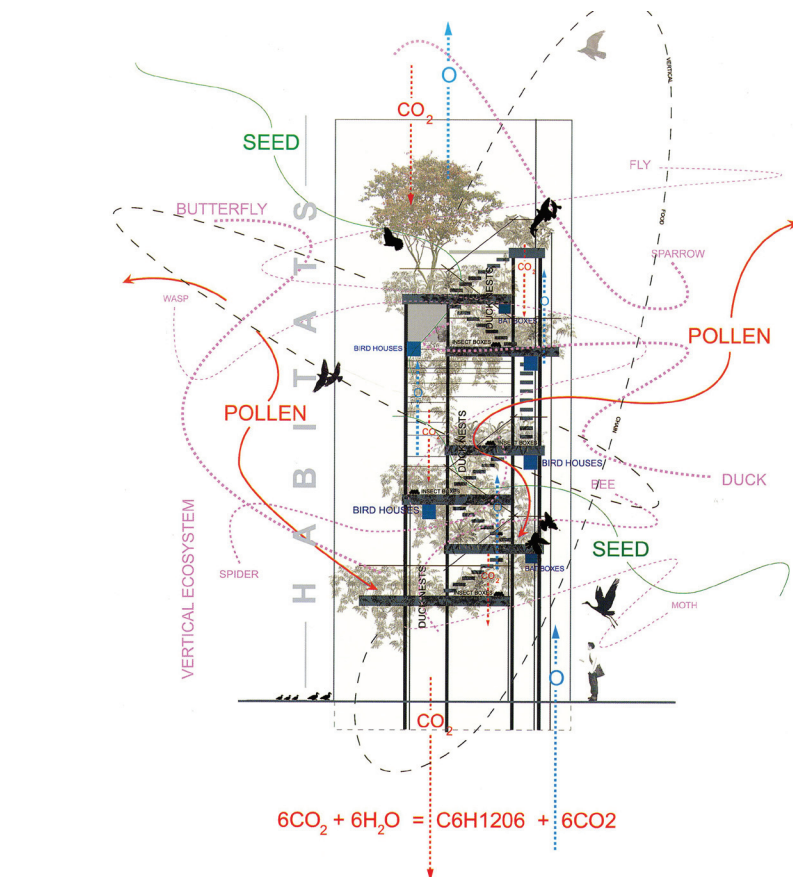


Fig. 09 Vertical Landscapes show the integration of Architecture and Landscape

environments.

Landscaping with Native Plants

Native plants are plants that have evolved naturally in particular area before the human introduction of foreign species. They can be incorporated into traditional landscape gardens or used more creatively in less conventional landscaping. Using native plants in landscape design results in a substantial savings of water and lower maintenance costs when compared with conventional landscape designs.³⁷ Native landscaping strengthens local cultural identity by re-introducing the natural heritage of an area, a

providing a vehicle for connecting urban residents to the natural world, and promoting a conservation ethic.³⁸

Living Strategies

Vertical Landscapes

Vertical landscapes are a strategy which show the potential for structural and formal continuity between landscape and architecture. Based on the tendency of plants to adapt growth to a structure and towards the direction of nutrient sources, vertical landscapes are able to redefine the idea of landscape as existing solely in the horizontal plane. These systems consists of a non-living structure which supports

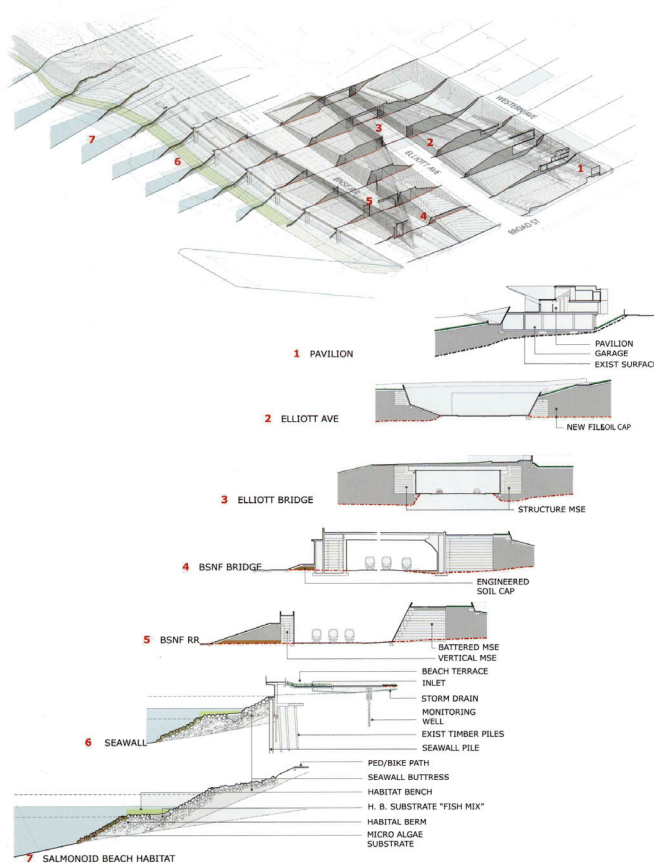


Fig. 10 Stratified Landscape redefines the ground as a three-dimensional profile

vegetation. The vegetation, in turn, provides a skin that can help to control light, air quality, and temperature. The structure could be transitional, biodegradable, permanent, or designed to evolve symbiotically, so as to adapt itself to different stages of growth.³⁹

3-Dimensional Profile

A stratified landscape strategy redefines the ground plane from a traditional material classification to an armature of 3-dimensional profiles housing dynamic living systems. They are arranged with a top interface layer down to a series of overlapping horizons within each site (Figure 10). These landscapes

can be on the top of a capped landfill or a roof structure, or floating within a watercourse.⁴⁰

Fluid

Fluid landscapes are designed to flexibly accommodate the cyclical and seasonal fluctuations of water flow and to flexibly manage water volume, frequency, and velocity. Since, the majority of surfaces in the built environment are impervious, these methods of small-scale, local water retention, and infiltration begin to compensate for the depletion of the nature sponge structures such as soil and wetlands, that were once widely dispersed to attenuate the volume of surges, as well as facilitate

ground water recharging.⁴¹

Maintenance Systems

Maintenance within landscape architecture is generally viewed as the preservation of a state. When viewed through the lens of living systems, maintenance instead is articulated as a responsive pattern of cultivation that enhances a more phenomenological reading of the landscape. Maintenance can be well-organized performance throughout the lifecycle of a landscape site.⁴²

Metabolic Systems

One way to view brownfields is as metabolic systems; in this view all materials and processes are inputs and outputs within a larger “food cycle.” This means that through site metabolism, material resources are generated, retained, balanced, and reconfigured into new resources. In response to the idea of metabolic systems, remediation proposals have begun to shift from off site pollutant removal to in-situ strategies. Additionally, new bio-based processes and technologies to increase physical and economic performance of disused sites are increasing and offer new opportunities to incorporate these processes into the spatial, aesthetic, and experiential layout of landscapes.⁴³

Conclusion

Sustainable landscape architecture takes into account economic, social, and environmental aspects of landscapes. There are many different approaches to landscape sustainability, but all would agree on a few key aspects. First, there

is no right solution that will produce a sustainable landscape everytime. Secondly, every proposal must be contextually responsive and specific. Finally, sustainable landscapes are not just about creating green spaces, but are about implementing design that can benefit both humans and ecosystems simultaneously.

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